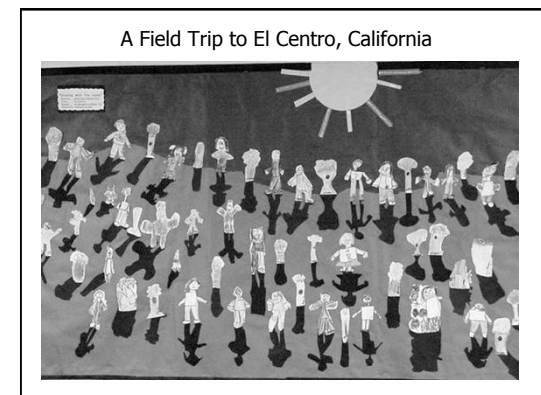
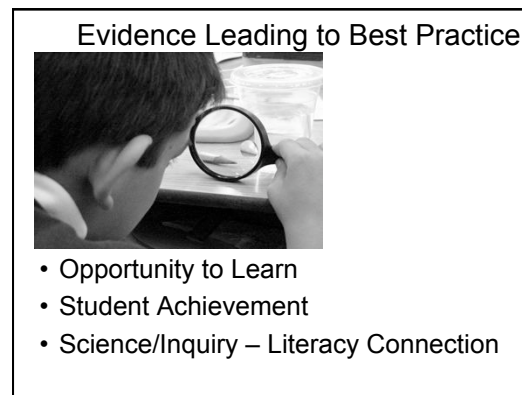
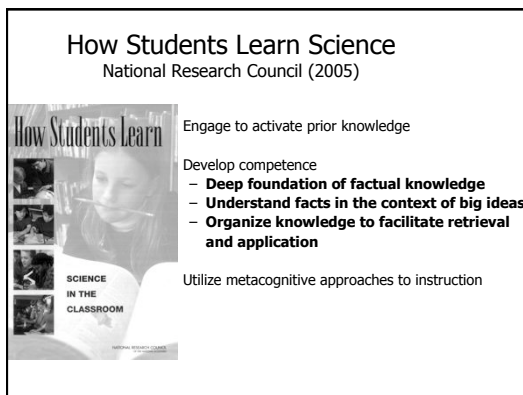
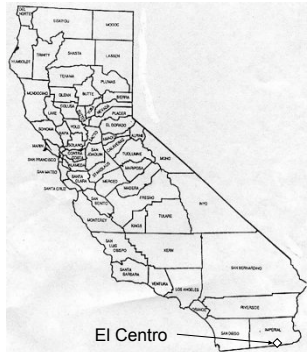


The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap



The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap

Where is El Centro?



Our Community and Students

In Imperial County

- Mean income \$16,322
- Poorest of all 58 counties in California
- 30% unemployment rate
- 22,500 students in 14 Districts



In El Centro



- 13,200 K-12 students
- 9 elementary, 2 middle, 2 high school
- All Title I, School-wide Project Schools
- 77% Free/Reduced Lunch
- 61% English Language Learners
- 10% Migrant
- 81% Hispanic, 12% Caucasian, 4% African-American, 3% Asian

Student Achievement – Imperial County, CA

- Stanford Achievement Test: Science Scores 1998-99 NPR - Sorted by Years in Program

Years CUM	Gr4 36	Gr6 40
0	21 n=137	27 n=174
1	32 n=150	32 n=121
2	38 n=141	42 n=132
3	47 n=111	50 n=107
4	53 n=91	64 n=104

Amaral, O., Garrison, L. and Klentschy, M. (Summer 2002). Helping english learners increase achievement through inquiry-based science instruction. Bilingual Research Journal, 26:2, 213-239.

Student Achievement – Imperial County, CA

- TIMSS Secured Multiple Choice: Science Scores 2000-2001 Mean Raw Scores- Sorted by Years in Program

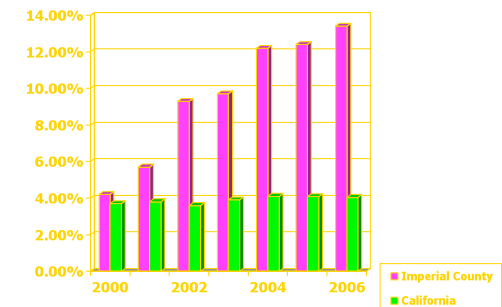
Years CUM	Gr7 9.4	Gr8 11.1	Gr7/8 10.2
0	8.7 n=48	10.0 n=107	9.5 n=155
1	8.9 n=136	10.5 n=103	9.7 n=239
2	9.0 n=168	10.7 n=112	9.8 n=280
3	10.4 n=125	11.1 n=90	10.7 n=215
4	11.0 n=84	13.3 n=93	12.7 n=177

p<.023

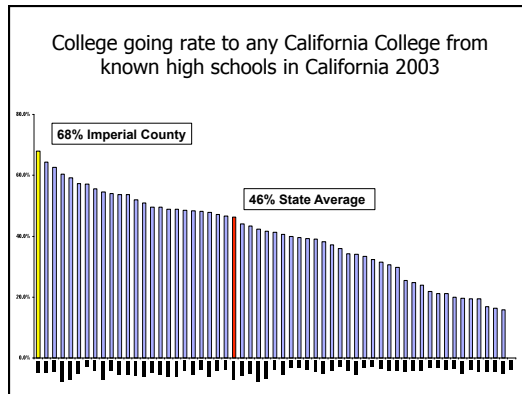
p<.001

p<.01

UC Eligibility Rate for Underrepresented Students



The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap



For additional information on this research and how a strong inquiry based science program also increased achievement scores in reading and mathematics...



Amaral, O., Garrison, L. and Klentschy, M. (Summer 2002). Helping english learners increase achievement through inquiry-based science instruction. Bilingual Research Journal, 26:2, 213-239.

http://brj.asu.edu/content/vol26_no2/pdf/ART2.PDF

Recent Evidence

In a study with more than 1200 5th graders using a process of scaffolded guided inquiry with embedded writing strategies experimental group students significantly outperformed the control group who received regular instruction using just kits and just textbooks on posttest, state science standards scores and writing scores.

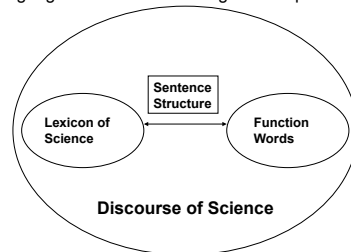
– EL closed achievement gap with EO students in experimental group

At a middle school with 288 8th graders (99.7% Free and Reduced Lunch, 77.8% EL), a similar method was used. 63% of the students scored Proficient or Advanced on the 2006 administration of the California Science Standards Test.

(Vanosdall, Klentschy, Hedges and Weisbaum, 2007
(Klentschy and Thompson, 2008)

Overview - Framework

Learning language in the context of science is crucial.
Language and content learning are inseparable.



Why integrate science and literacy?

- There is evidence that an integrated approach is beneficial for student achievement in both science and literacy
- Science provides a context for reading, writing and talk
- Has potential for EL student development of academic language
- Inquiry strategies and comprehension strategies are similar

Inquiry and Comprehension

- Posing questions
- Making predictions
- Setting goals and making plans
- Visualizing and using mental models
- Making inferences
- Synthesizing information from multiple sources
- Making evidenced-based conclusions

The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap

What About EL Students?

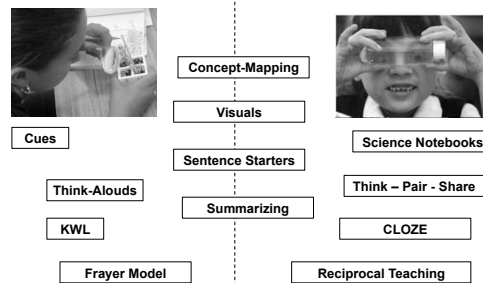
•ELD Strategies

- SLOP – Sheltered Instruction Observation Protocol
- CALLA -Cognitive Academic Language Learning Approach

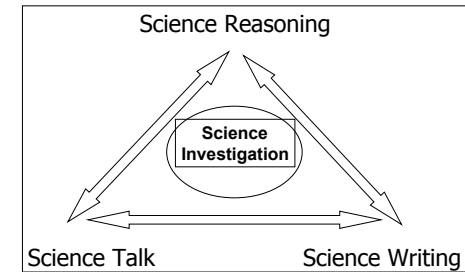
•Academic Content Language Development



Literacy Strategies Used for Science Learning



Science Inquiry



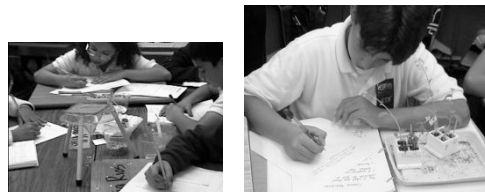
Talk

When students talk about science, they

- Clarify and develop their thinking and ideas
- Hear the thinking and ideas of others
- Consider and evaluate multiple perspectives and ideas
- Reconsider their ideas
- Challenge a current idea or thinking
- Support and rehearse their ideas for writing

Making Connections

- It is important for instruction to focus on connecting new words with what students already know.
- Cognates (liquid – líquido)



Cognates

English Everyday Word	English Science Word	Spanish Everyday Word
home	habitat	hábitat
adjust	adaptation	adaptación
animal	animal	animal
food	nutrient	nutriente
damp	humid	humedad
plant	plant	planta
bug	millipede	milpiés
germs	bacteria	bacterias

The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap

Words Are Concepts

Recognition	Definitional
Recognizing word when it is heard or read.	Knowing what the word means.
Relational	Contextual
Understanding how the word is related to other words.	Being able to use the word in various appropriate contexts.

Kit Inventory Objectives

- Vocabulary development
- Oral language practice
- Active experiences



Kit Inventory "Big Idea"

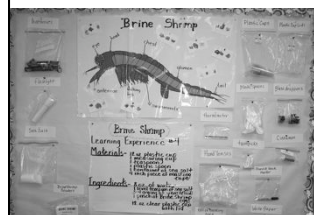
- Introduction to unit
- Where have you seen this before?
- What color is it?
- What will we use this for in the unit?



Kit Inventory

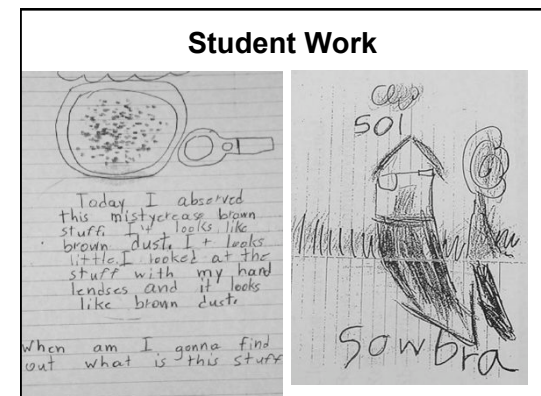
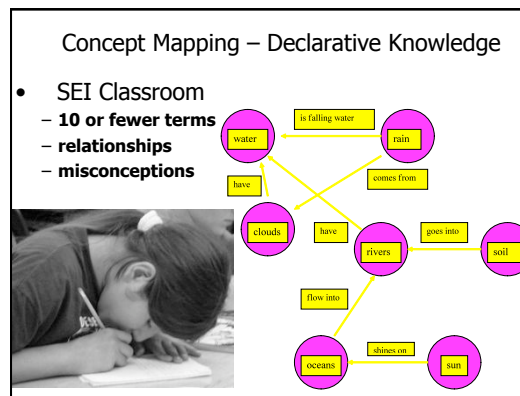
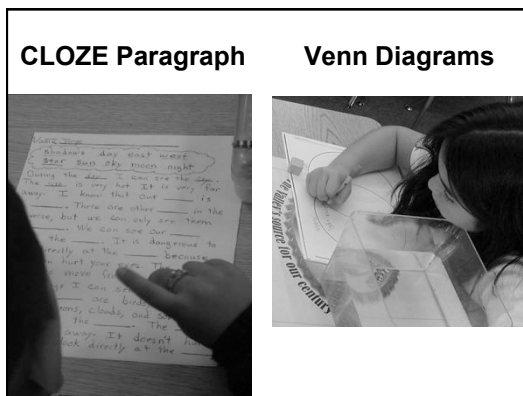
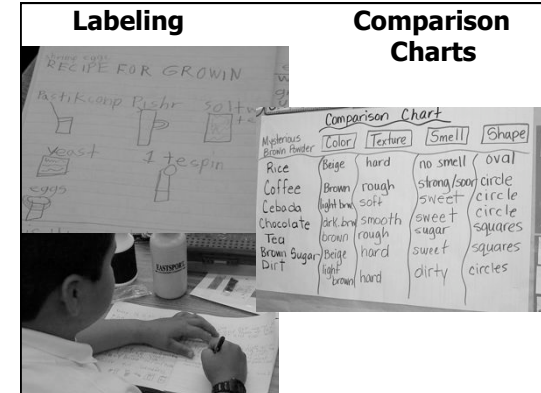
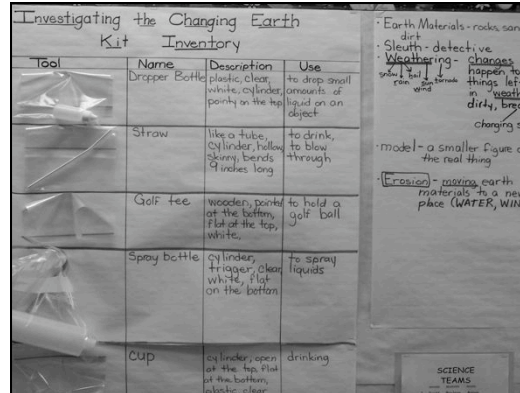
Working Word Walls and Charts

- Comprehensible input
- Scientific vocabulary
- Kit vocabulary
- Facilitates notebook entries



Investigating Properties of Powders			Reactions With
	KIT Inventory		Powder Vinegar Red Cabbage Juice Eosin
Petri Dish	rectangular, thin, wooden, plastic, clear, 2 ports on the lid	used to contain substances	Salt no rxn no rxn no rxn
Stir Stick	rectangular, thin, wooden, 4 1/2" long	used to stir	Alum no rxn Pink Purple no rxn
Magnifying Glass	clear, plastic, 2 lenses, shaped like a lightbulb, 4 1/2" long, shiny	used to magnify small objects	Baking Soda bubbles form no rxn
Medicine Cup	shaped like a cup, plastic, milliliters measurements	used to measure medicine	Corn Starch no rxn no rxn turned black
Plastic Cup	plastic, cylinder, clear, 4 1/2" long, round, dull	used to hold liquids and mixtures	Talcum Powder no rxn no rxn no rxn
Dropper Bottle	plastic, flexible, dull, white lid, 4" long	used to drop liquids	
Measuring Spoon	numbers on the handle, like measuring spoons, plastic, green, different sizes	used to measure substances	
	6 circles, paper, white, flat	used to observe powders	

The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap



The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap

Benefits Oral Language Development

- Precise science terminology, Academic Content Language Development (ACLD)
- Introduction and repetition of vocabulary
- Word walls
- Oral presentations
- Posing questions
- Appropriate framing in grammar structures
- Association of vocabulary to items in real world context

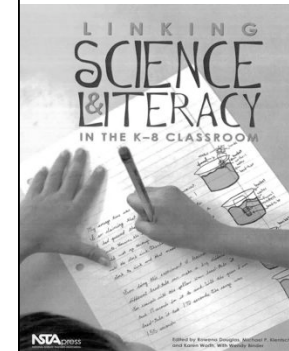


Benefits - Reading

- Repeating
- Sequencing
- Predicting
- Comparing
- Contrasting
- Inferring
- Analyzing
- Summarizing



Science-Literacy Connection

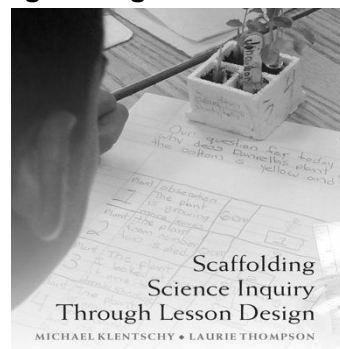


- Best Practices
- Research-Based Strategies
- Lessons Learned

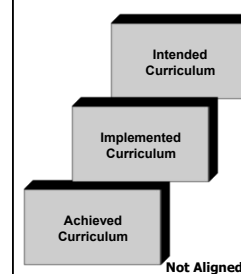
Evidence from Imperial County, California

- Stanford Achievement Test: Reading Scores
 - Study found that students who received 4 years of exposure to a systemic science program (1996-1999) scored significantly higher on the SAT 9 Reading subtest compared to students who did not receive the science instruction. Mathematics and writing scores were also positively affected and mirrored the gains in reading.
 - Opportunity to learn in the systemic science program produced achievement results that closed the reading achievement gap between EO and ELL students.
 - In all cases, a positive relationship was found between the number of years of participation in the systemic science program and SAT 9 Reading Score gains

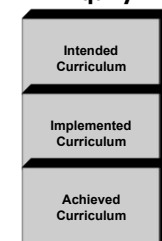
Strengthening Lesson Planning



Before

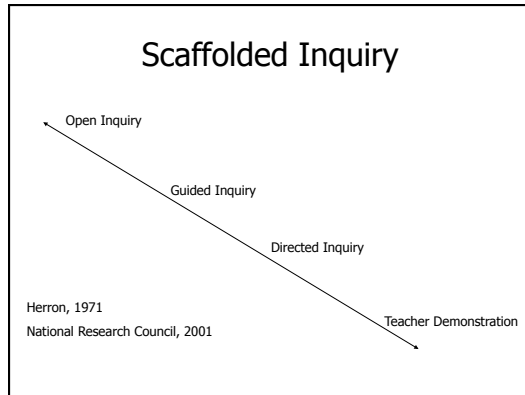


Scaffolding Guided Inquiry



Based on Marzano (2001)

The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap



How Students Learn Science

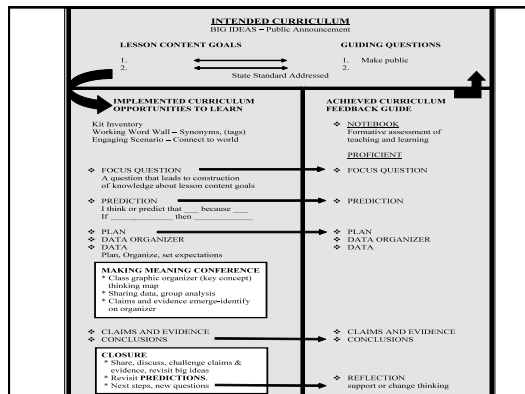
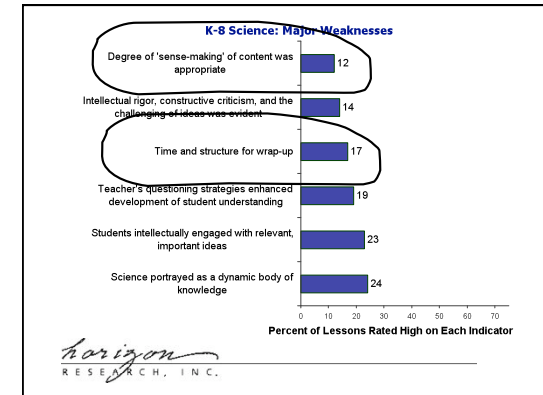
National Research Council (2005)

Engage to activate prior knowledge

Develop competence

- Deep foundation of factual knowledge
- Understand facts in the context of big ideas
- Organize knowledge to facilitate retrieval and application

Utilize metacognitive approaches to instruction



Science - Literacy

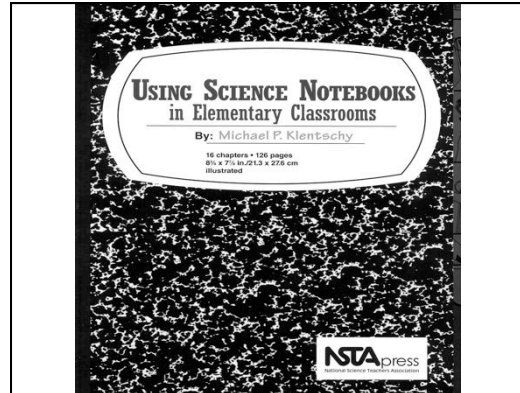
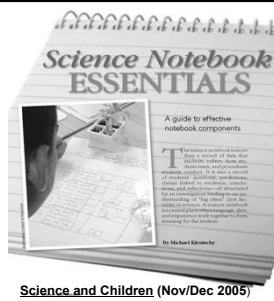
- Notebooks

Things to Consider About Notebooks

- Best Record of
 - Lesson/Unit Implementation
 - Student Performance
 - Quality of communication
 - Conceptual and/or procedural understanding
 - Teacher Feedback

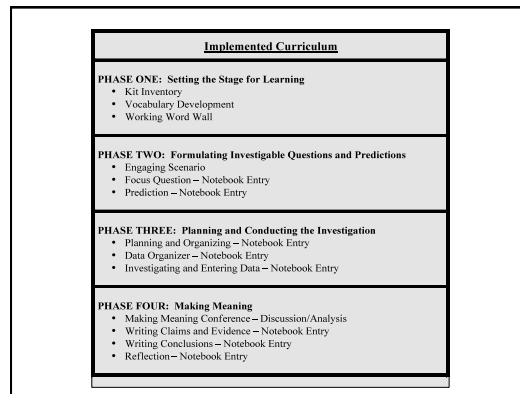
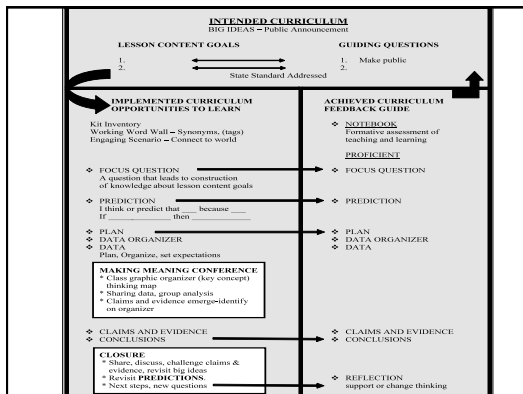
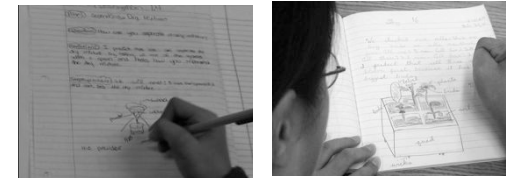
Ruiz-Primo, Li and Shavelson, 2002, Looking Into Student Science Notebooks: What Do Teachers Do With Them? CRESST Technical Report 562.

The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap

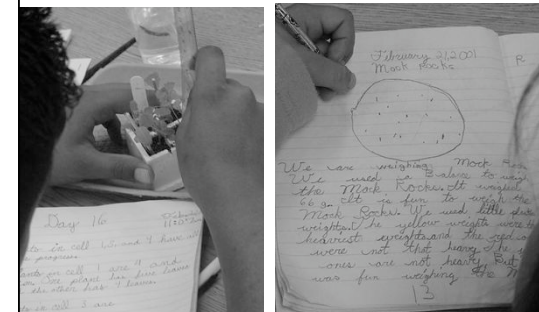


Benefits - Writing

- Expository genre is reinforced
- Use of precise language
- Language is connected to students' immediate experiences
- Enhancing writing conventions



What should a science notebook contain?



The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap

Components and Criteria

- Question/Problem/Purpose
- Prediction
- Planning
- Data/Observations
- Claims and Evidence
- Conclusions
- Reflection

Component	Purpose	Writing Scaffold
Question	The question provides a link to the engaging scenario and is investigable.	<i>How does ...? How can ...? What does ...? What can ...? Which ...?</i>
Prediction	The prediction provides a reasonable explanation by the learner as to the result of the investigation. Using "because" also activates prior knowledge.	<i>I think ... will happen because ...</i>
Planning		
-general	The general plan determines which variable will be changed and which will be kept constant and what will be observed or measured.	general <i>... will be changed. ... will be kept the same. ... will be observed or measured.</i>
-operational	The operational plan describes the sequence of events and the materials that will be used to conduct the investigation.	operational <i>First ... Second ... Next ... Finally ...</i>
Data - Observations/Measurements	Data charts, tables, graphs and labeled diagrams and illustrations.	<i>How are we going to record what we are going to observe or measure?</i>
Claims/Evidence	Claims linked to the data collected or observed.	<i>I claim ... I know this because ...</i>
Conclusion	What was learned from the evidence. Revisit prediction.	<i>Today I learned ... My prediction was correct because ... My prediction needs to be revised because ...</i>
Reflection	Provides an opportunity for the student to think about their thinking.	<i>Questions that I have now are ... I wonder if ... What really surprised me about this investigation was ... I used to think, but now I think ... I know that ... but I'm still not sure of ... I'm confused about ...</i>

FOCUS QUESTION

Is a simple question directly related to the scenario that can be investigated with results that can be communicated.

Cannot be answered "yes" or "no".

- "How can we find out ... ?"
- "In which order ... ?"
- "What does ... ?"

Today is Oct. 26, 2008.

Lesson 3 Day 1 11/7/08 1:47:13
Class Focus Question!
Where does blood with oxygen and blood with carbon dioxide and wastes go in the body, and where do they come from?

Focus Question
How can we describe the minerals? How can we put them in order from soft to hard?

Investigation 1- Making & separating mixtures
Focus Question?
How can I make a mixture and then separate it into its original parts?

PREDICTION

Is a reasonable explanation by the learner as to the result of the investigation. Using "because" also activates prior knowledge.

"If then will happen because"

Or

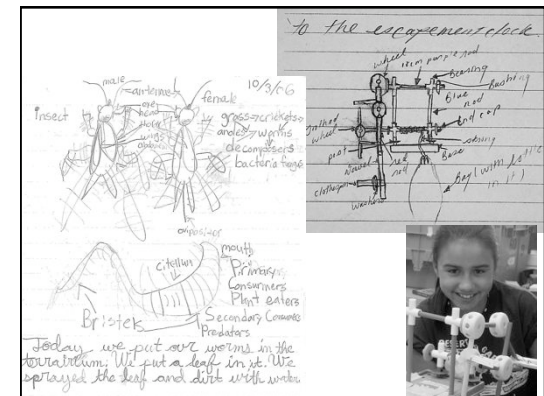
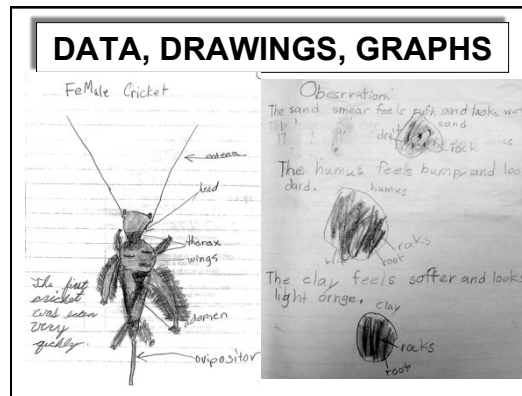
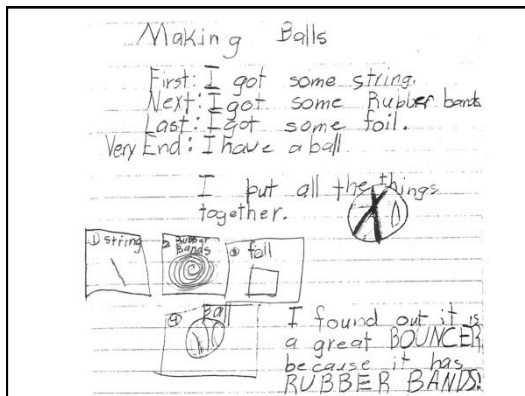
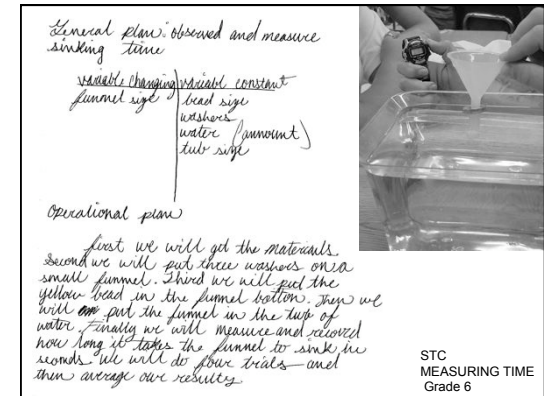
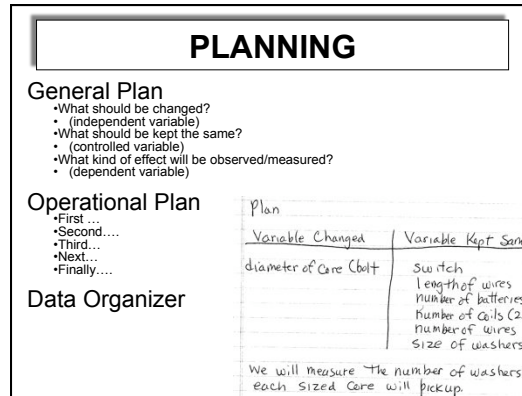
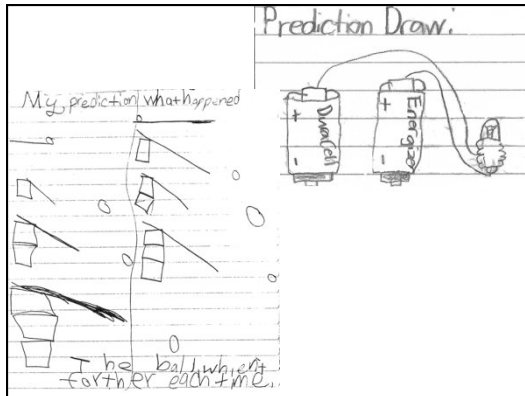
"I think will happen because"

Prediction using "because"

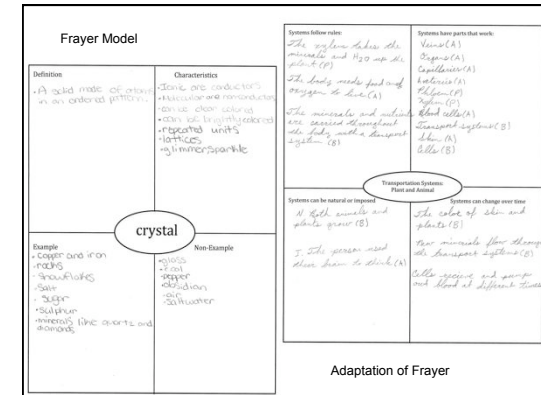
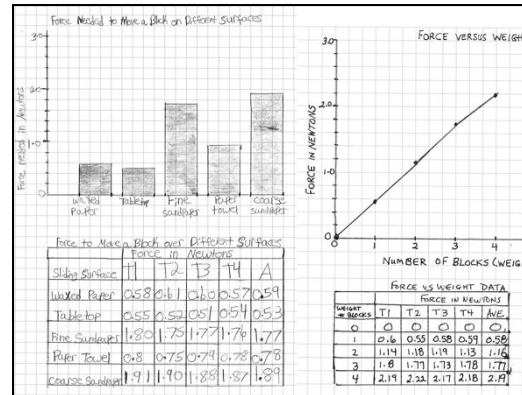
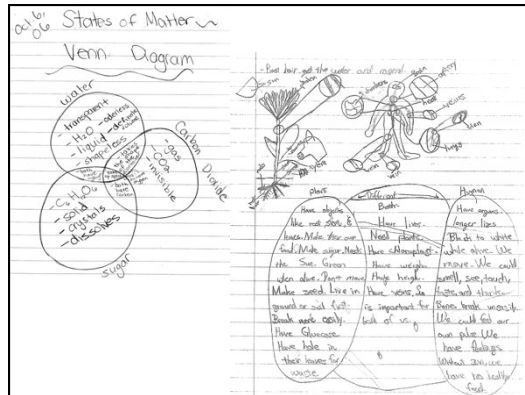
Focus Question:
How are transportation systems of plants and animals different?

Prediction: I think that transportation systems are different in plants and animals, because animals take in food in their mouths and plants don't have a mouth.

The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap



The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap



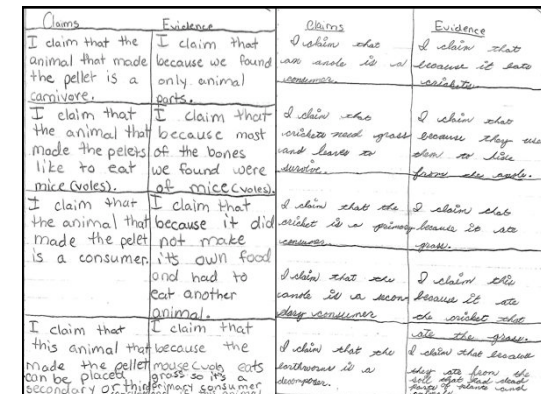
Making Meaning Conference

- What patterns can we see from our data?
- What about the outliers?
- What claims can we make?
- What evidence do we have to support our claims?

Writing Claims Supported by Evidence

I claim that	I claim this because
I know that	I know this because

How does the evidence support your claim?
How was the evidence sufficient?



The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap

Claims and I claim that...	Evidence because... 10/24/06
① a metal object (rivet) can be made into a magnet	when we connected it to a simple series circuit it could attract many small washers
② a temporary magnet can be turn on and off	when it is "off" it does not attract metal washers
1. I claim that a metal object (rivet) can be made into a magnet because when we connected it to a simple series circuit it could attract many small washers.	
2. I claim that a temporary magnet can be turn on and off because when it is "off" it does not attract metal washers.	

CONCLUSION

Look at your prediction again. How did the evidence support your prediction?

Do you wish to affirm or revise your prediction? Why?

My evidence confirms my prediction because.....

My evidence does not confirm my prediction because...

Conclusion:

The evidence did not support my prediction because I thought potting soil would grow taller, but really mixture soil grew taller.

CONCLUSION

My evidence does not confirm that I may see the colors of cheek and onion cells because I learned that there was no color in the cells. I also learned that scientists use coloring to see the cells. This is my conclusion.

My evidence confirms that if I look through a microscope I would see some big circles and little circles. But after I learned more about cells I learned that the circles are called nucleus and are like the heart of a cell.

CONCLUSION

Write a concluding sentence using one of the stems:

"Today I learned ... "

or

"In conclusion, ... "

Conclusion: 10-6-06

I learned that some rock come from volcanoes. If they come from volcanoes, then they are called igneous rock. Two examples that are igneous rock are obsidian and pumice. I learned that pumice rock has tiny holes. Those holes are pockets of air.

Conclusion:

We found that we could make 2 bulbs burn equally bright by using only 1 D-cell battery if we created a parallel circuit.

REFLECTION

Think about the investigation we just completed. Use one of the stems below to write a reflection regarding the investigation.

What if ...?

What really surprised me about this investigation was ...?

A new question I have now is ...?

I want to know more about ...?

I am confused about ...?

The Impact of Inquiry-Based Science Programs on Student Achievement, English Learners, and Closing the Achievement Gap

Reflection: Would anything have happened to the hot water if we had put more than 20 ml of cold water? If we had put just 10 ml of cold water into the 20 ml of hot water would the cold water still had gone to the bottom of the bottle and the hot had been on top of the cold water?

* Reflection:

1. My prediction was right, because the nylon spacer did sink to the bottom of the water and the cylinder did sink all the way to the bottom.
2. I want to know if the same result will be with hot coffee?
3. I would like to drop an eraser in to see what it would do. Will the eraser sink or float?

3-2-98
2:54

Today was the saddest day in my life, I had to kill four of my plants.

Here is some of the plants

